INTERAGENCY MEMORANDUM

To: **Cooperating Agencies in the NorthMet Project EIS**

From: **NorthMet EIS Project Managers**
Michael Jimenez (USFS); Ralph Augustin (USACE); Lisa Fay/Bill Johnson (MDNR)

Re: **NorthMet Environmental Impact Statement**
Co-lead Agencies' Response for GLIFWC Comments on Calibration of the Mine Site MODFLOW Model to Partridge River Groundwater Baseflows

July 10, 2015

The Co-lead Agencies for the NorthMet EIS received comments from the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) on the Mine Site groundwater flow model calibration and predictions used for EIS preparation. GWIFWC's position on this issue was further elaborated in a letter to the Co-lead Agencies (GLIFWC, June 18, 2015). GLIFWC noted that the Mine Site MODFLOW model, intended to represent recent conditions, was calibrated using Partridge River groundwater baseflows determined from historic 1980s low flows measured at a downstream gaging station near Colby Lake. GLIFWC further noted that the Northshore pit water level used in the MODFLOW model for calibration (493 m msl) did not conform to the estimated water level (483 m msl) that existed at the time of the stream gaging data used to estimate Partridge River groundwater baseflows.

GLIFWC noted, "The significance of this is that the MODFLOW model was calibrated (adjusted to fit reality) to baseflow in 1986-88, yet the Peter Mitchell pit water levels used as boundary conditions in calibration [493 m msl] were those that occurred in 1996, not those that occurred in 1986-88 [483 m msl]." GLIFWC concludes "this mis-match of boundary conditions and calibration targets is that the model is incorrectly calibrated and cannot be expected to produce accurate predictions."

GLIFWC's interpretation was that the Partridge River groundwater baseflows that occurred during 1980s were lower than recent groundwater baseflows due to the effects of variable water levels in the Northshore pits. GLIFWC asserted that the calibration of the MODFLOW model should use either 1980s Northshore water levels in conjunction with the measured 1980s groundwater baseflows ***or*** recent Northshore pit water levels with estimated recent groundwater baseflows.

Based on the information detailed in the remainder of this Interagency Technical Memorandum, the Co-lead Agencies conclude the groundwater baseflow values used to calibrate the current-conditions Mine Site MODFLOW model, and used as inputs to the GoldSim water quality model, represent reasonable estimates of current hydrologic conditions for the Partridge River at the NorthMet Mine Site.

MNDNR

US Army Corps of Engineers
St. Paul District

The Co-lead Agencies also believe that the separate groundwater baseflow sensitivity analysis adequately addresses GLIFWC's Option #2, (e.g, "recent Northshore pit water levels with estimated recent groundwater baseflows"). The results of the groundwater baseflow sensitivity analysis indicate that estimated constituent concentrations show some sensitivity to the increase in groundwater baseflow values at the respective evaluation locations. Despite this effect, the NorthMet Project Proposed Action does not exceed applicable water quality evaluation criteria. This applies even for the unlikely case of groundwater baseflows being 4 times higher than the values used in the EIS, which is higher than GLIFWC's Option #2. Consequently the Co-lead Agencies conclude that there is no methodology-based justification for changing the groundwater baseflow values used in calibrating the Mine Site MODFLOW and GoldSim models for water resources impact evaluation in the FEIS.

The Co-lead Agencies offer the following response regarding the "groundwater model calibration and predictions" comments as detailed in the June 18, 2015 GLIFWC correspondence. The PolyMet/Barr team supplied information from available research and data to assist the Co-lead Agencies in developing this response.

1.0 Background

As part of the NorthMet EIS water resources impact evaluation, a numerical three-dimensional groundwater flow model was developed by PolyMet for the NorthMet Mine Site and surrounding area. The model was developed using the public domain U.S. Geological Survey (USGS) program MODFLOW NWT in combination with Goundwater Vistas®, a commercially available pre- and post-processor program for MODFLOW. As documented in Mine Site Water Data Package v14 (Barr; February 27, 2015; Attachment B), the base MODFLOW model for the Mine Site effects analysis was a steady-state simulation that was calibrated to:

- recently measured hydraulic heads in surficial deposits (up to 2013);
- measured heads in bedrock (2006 to 2013); and
- also calibrated to groundwater baseflows in the Partridge River using the XP-SWMM surface water model that was calibrated to USGS gage data at SW-006 (Sept 1978 – Nov 1988).

See Table 1 for the Partridge River groundwater baseflow values used in EIS-related modeling.

Table 1 Groundwater Baseflows Used to Calibrate the EIS Mine Site MODFLOW Model

Partridge River Station	Groundwater Baseflow used for FEIS MODFLOW Calibration[(a)] (cfs)
SW-002	0.41
SW-003	0.51
SW-004	0.92
SW-006 [(b)]	5.27

[(a)] Source: Mine Site Water Data Package v14 (Barr; February 27, 2015)
[(b)] Same as historical USGS gaging station #04015475

For purposes of EIS-related water resources impact assessments the term "groundwater baseflow" is defined as the long-term average discharge to the Partridge River of groundwater from regional surficial

deposits and bedrock excluding for the Northshore Mine area. It is acknowledged that groundwater baseflow values vary from year to year due to weather variations. Thus, the characterization of groundwater baseflow as a single value (at a specific stream location) is a simplifying assumption used for modeling the effects of the NorthMet Project Proposed Action.

Note that groundwater baseflow does not include other sources of flow to the Partridge River such as surface runoff, temporary bank storage, and Northshore-related discharges including pumped discharges, seepage from the Area 003 West pond, and wetland storage-and-release mechanisms associated with those discharges. Groundwater baseflow as defined for the EIS is ***not*** synonymous with measured low-flows in the river (e.g., 30-day low flows) ***unless*** the effects of Northshore discharges are accounted for when evaluating measured flows. Flow contributions from the Northshore mine-impacted watershed are treated as a separate input for the water modeling impact assessment. Note that in Northshore closure (post-2070) it is expected that there will be no Northshore-related flow contributions to the Upper Partridge River.

The Northshore discharges to the Partridge River are a combination of controlled pumping from the Peter Mitchell Pit, uncontrolled seepage, and occasional surface discharge from the Area 003 West pit lake. The amount of pumping and its temporal distribution varies depending on pit operations and weather conditions. Pumping from the Peter Mitchell Pit to the Partridge River can occur at high flow rates (many 10s of cfs) for durations of several days, followed by longer periods with no pumping. The Northshore discharges are reported to MDNR as monthly volumes rather than flow rates. Monthly volumes resolved into average monthly flow rates are shown on Figure 1. Note that these flows are estimated from pump curves and pump run times and could have inaccuracies. Also, the flows on Figure 1 do not include seepage and surface discharge from the Area 003 West pit lake that likely reaches the Partridge River. Finally, there are also periods when Northshore reported no pumped discharges from the Peter Mitchell Pit to the Partridge River; these were January to February 1985, November to December 1985, and October to December 1986.

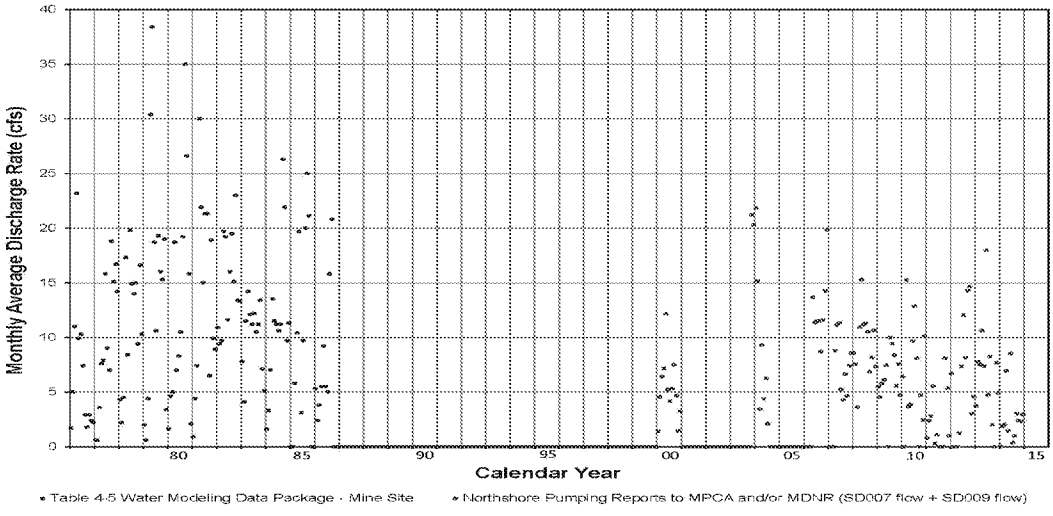

Figure 1 Monthly Average (24/7) Pumped Flow Rate from Peter Mitchell Pit to Partridge River

The groundwater baseflow value for SW-006 in Table 1 is based on water year stream flows measured at USGS gaging station number 04015475 located on the Partridge River just above Colby Lake. A water year (WY) goes from October of the preceding year through September of the designated water year. The measured 30-day low-flow at SW-006 for WY 1986 was 8.74 cfs, which occurred between Jan-Feb 1986. The low-flow for WY 1987 was 1.21 cfs, which occurred between Feb-Mar 1987. These two low-flows average to 4.98 cfs, and this was taken as a preliminary groundwater baseflow rate at SW-006.

For SW-006 and the remaining stations in Table 1, XP-SWMM was used to scale the groundwater baseflows at other upstream Partridge River stations based on their associated contributing watershed areas. The XP-SWMM model was initially calibrated to WY 1985, and validated against the entire 10-year gaged period corresponding to WY 1979-1988, adjusted to account for Peter Mitchell Pit dewatering. Because the XP-SWMM model is intended to assess relative hydrologic impacts (versus "predict" instantaneous flows), model results are multiplied by "scale factors." The scale factors vary according to the flow statistic of interest, and are based on observed data from the period when the Peter Mitchell Pit was not dewatering (October 1986 through September 1988). The goal of the XP-SWMM model was to represent average conditions without the influence of the Peter Mitchell Pit dewatering. As a result the SW-006 preliminary value of 4.98 cfs was adjusted upward slightly to 5.27 cfs; see Mine Site Water Data Package v14; Sections 4.4.1.2.6 and 4.4.1.2.7 (Barr 2015).

Other relevant background includes:

> Groundwater Baseflow Yield. Inflow of water to a groundwater body from the surface is known as recharge or groundwater baseflow yield; this can be calculated for any given watershed. When the SW-006 groundwater baseflow value is normalized to its contributing natural, undisturbed watershed area of approximately 97 mi^2, the groundwater baseflow yield in the Upper Partridge River computes to 0.054 cfs/mi^2. Doing the same analysis for the adjacent Embarrass River watershed using data collected between 1942-1963 (which did not have Northshore or other influences) provided a groundwater baseflow yield of 0.045 cfs/ mi^2. These two values are reasonably similar for neighboring watersheds.
>
> DNR Gaging Station at SW-003. Partridge River flow data are available from a DNR gaging station recently installed at SW-003. A low-flow analysis of this data by MDNR (December 17, 2013) gave a range of 1.3 to 1.8 cfs. When considering whether to use this data in the EIS modeling, the Co-lead Agencies concluded that it is difficult to separate the Northshore discharges from the existing SW-003 flow data in order to estimate groundwater baseflow. Although not incorporated into the EIS modeling, the DNR gaging station data at SW-003 were considered by the Co-lead Agencies in determining the values used in a groundwater baseflow sensitivity analysis.

In light of all these factors the Co-lead Agencies conclude the groundwater baseflow values listed in Table 1 (based on the SW-006 data) account for potential Northshore Mine discharges (i.e., they are regarded to be absent) and are considered a reasonable estimate of recent conditions for FEIS MODFLOW calibration and as inputs to the FEIS GoldSim model effects analysis (MDNR; March 5, 2014).

1.1 Cooperating Agencies Communications Regarding Groundwater Baseflow and MODFLOW Calibration

There has been much discussion on the issue of groundwater baseflows to the Partridge River stemming from comments on the SDEIS and communications between the Co-lead Agencies and Cooperating Agencies. The Tribal Cooperating Agencies in particular have provided comments and memoranda stating their opinion that the baseflows used to calibrate the MODFLOW model (and also used as input to the GoldSim model) are erroneously low.

In a letter from GLIFWC dated June 18, 2015, specific concerns were raised about: 1) groundwater baseflows used to calibrate the FEIS models; and 2) bedrock groundwater flow directions between the NorthMet and Northshore mine sites. The flow direction issue is addressed in a separate Co-lead Agencies' memorandum while the groundwater baseflow calibration issue is addressed in this memorandum.

For groundwater baseflows, the GLIFWC letter raised concerns about the use of 1980s stream gaging data at SW-006 to calibrate the FEIS MODFLOW model, which is intended to represent recent conditions. Due to low pit water levels at Northshore's operations during this time period, GLIFWC contends that groundwater baseflows interpreted from 1980s data are lower than the current groundwater baseflows. GLIFWC concludes: "The result of this mis-match of boundary conditions and calibration targets is that the model is incorrectly calibrated and can not be expected to produce accurate information."

1.2 Analysis

The Co-lead Agencies' review of the summary illustration attached to the GLIFWC letter (Figure 2 herein) suggests that during the 1980s, the Northshore pits intercepted approximately 0.93 cfs of groundwater that otherwise would have become groundwater baseflow to the Partridge River. The Co-lead Agencies further interpret the GLIFWC line of reasoning to suggest that groundwater baseflow at SW-006 could currently be 0.93 cfs higher than the value listed in Table 1, and this would give an Upper Partridge River groundwater baseflow yield of 0.064 cfs/mi2, which is approximately 18% higher than the FEIS value (0.054 cfs/mi2). Applying this higher groundwater baseflow yield (derived from GLIFWC's asumptions) to the other MODFLOW calibration stations would lead to the values summarized in Table 2.

Table 2 Possible Groundwater Baseflows Interpreted by Co-lead Agencies Based on Information Provided in GLIFWC Letter Dated June 18, 2015

Partridge River Station	FEIS Groundwater Baseflow (cfs) (Table 1)	Possible Current Groundwater Baseflow Based on GLIFWC Letter (cfs)
SW-002	0.41	0.48 [(c)]
SW-003	0.51	0.60 [(c)]
SW-004	0.92	1.09 [(c)]
SW-006 [(b)]	5.27	6.20 [(a)]

[(a)] Add 0.93 cfs to SW-006 groundwater baseflow estimated from 1980s gaging data (5.27 cfs), which increases SW-006 groundwater baseflow by 18%.

[b] Same as historical USGS gaging station #04015475.

[c] Assuming more or less uniform recharge (groundwater baseflow yield) throughout the natural watershed, increase groundwater baseflow at other stations by 18%.

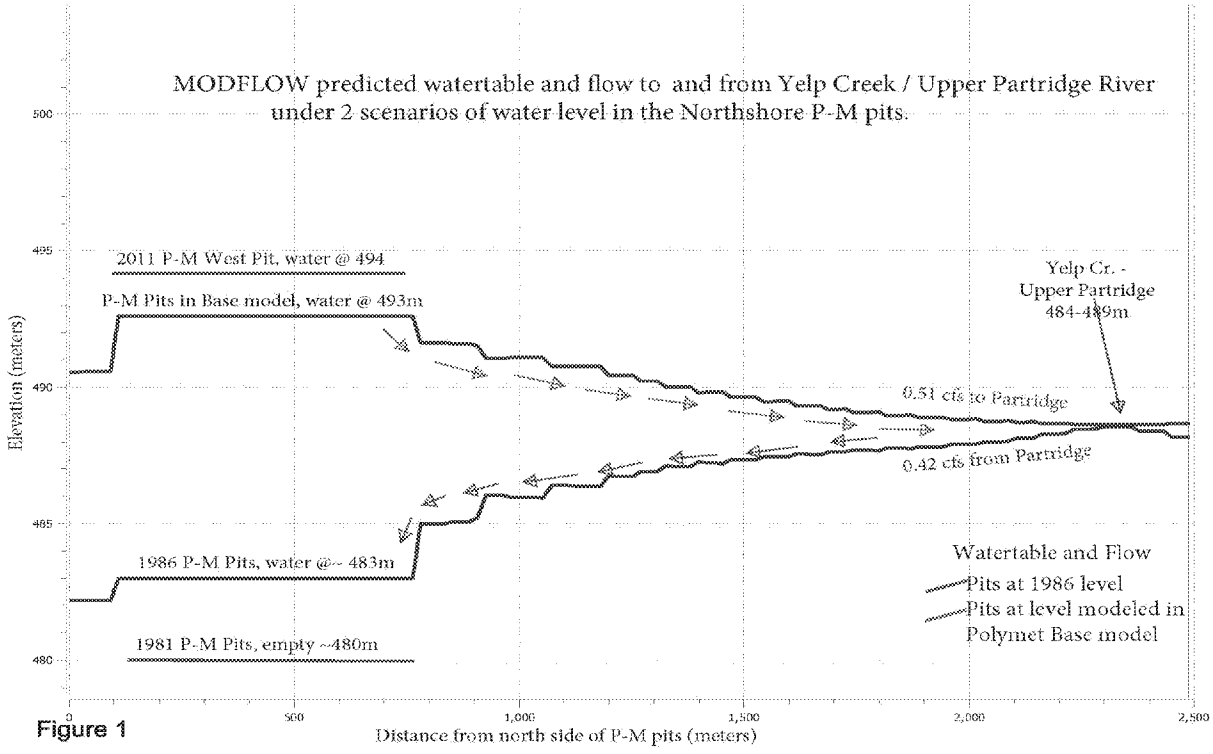

Figure 1

Figure 2 GLIFWC Summary Illustration from June 18, 2015 Correspondence

Whereas the Co-lead Agencies continue to consider the Table 1 groundwater baseflows as reasonable values that should be retained for FEIS modeling, the *possibility* that the Table 2 values could exist for current conditions is acknowledged. In this context the Co-lead Agencies note the GLIFWC letter further states:

"There appear to be two options to resolve these fundamental errors:

Calibrate the MODFLOW model to 1986-88 conditions, with the P-M pits set at their correct late 1986 to early 1988 levels, and use the 0.51 cfs baseflow rate at SW003 (and other 1986-88 baseflows at other stations) as targets. This would result in a very different hydrologic model for the site so as to account for the loss of groundwater to the P-M pits. This appears to be a poor option because of the significant uncertainty about the baseflow in the Partridge River in 1986-88 and uncertainty about the exact level of water in the P-M pits. [Referred to herein as **GLIFWC Option #1**]

Or

Calibrate the MODFLOW model to 2011 conditions, with the multiple P-M pits at their known 2011 water levels of 483 to 499m (pit water elevations are available for that year), and use estimates of baseflow at

SW003 based on current data. There is more certain information for both the water levels in the taconite pits and the baseflow in the Partridge River. The December 2013 DNR analysis of 2011-12 flows at SW003 indicate that "minimum winter base flows" in the range of 1.3 to 1.8 cfs are reasonable." [Referred to herein as **GLIFWC Option #2**]

The Co-lead Agencies do not consider GLIFWC Option #1 to be a viable option because other calibration data, such as measured groundwater levels in surficial deposits and bedrock, would be limited or nonexistent for the mid-1980s time period. The Co-lead Agencies do consider GLIFWC Option #2 to be a workable approach for investigating the effect of higher groundwater baseflows on predicted water quality and quantity effects associated with the NorthMet Project Proposed Action. If pursued, GLIFWC Option #2 would increase the groundwater baseflows at all locations used to calibrate the MODFLOW model by a factor of 2.5 to 3.5 times higher than the groundwater baseflows used to calibrate the FEIS model (listed in Table 1). This is also much higher than the approximately 18% increase interpreted from the illustration attached to the GLIFWC letter (See Figure 2).

2.0 Co-lead Agencies Directed Groundwater Baseflow Sensitivity Analysis

Because of issues raised by the Cooperating Agencies on the groundwater baseflow estimates being used in the EIS-related water resources impact assessments, the Co-lead Agencies directed PolyMet to conduct a comprehensive sensitivity analysis (using both the MODFLOW and GoldSim models) to assess if higher groundwater baseflows would cause the NorthMet Project Proposed Action to exceed applicable water quality evaluation criteria. The idea was to evaluate NorthMet Project Proposed Action effects using significantly elevated groundwater baseflows to test model sensitivity for this parameter. If the analysis showed that unacceptable NorthMet Project Proposed Action effects were predicted for the higher groundwater baseflows in the Partridge River, then there would be justification to further investigate and characterize groundwater baseflows within the Partridge River watershed and potentially modify the predictive models accordingly. On the other hand if the analysis showed that NorthMet Project Proposed Action effects remained acceptable (e.g., that is, would continue to meet the applicable water quality evaluation criteria), then it would be concluded that while groundwater baseflows have some uncertainty, the range of uncertainty does not affect the NorthMet Project Proposed Action's predicted ability to meet the applicable evaluation criteria.

Although the groundwater baseflow sensitivity analysis was performed in January 2015 prior to receipt of the GLIFWC June 18 letter, the Co-lead Agencies consider the sensitivity analysis as being consistent with GLIFWC Option #2. For the groundwater baseflow sensitivity analysis, all groundwater baseflows along the Partridge River were increased by a factor of 4 as shown in Table 3. The factor of 4 increase is greater than the range proposed in the GLIFWC Option #2 recommendation (2.5 to 3.5 times higher) and is much greater than the approximately 18% increase suggested by the Co-lead Agencies' interpretation of the GLIFWC illustration.

Table 3 Groundwater Baseflows Used for Sensitivity Analysis (Barr, January 2015)

Partridge River Station	Groundwater Baseflows used for Sensitivity Analysis (cfs)
SW-002	1.62
SW-003	2.04
SW-004	3.66
SW-006	21.1

Details of the groundwater baseflow sensitivity analysis are provided in the report Sensitivity Analysis of the NorthMet Water Quality Models – Version 2, NorthMet Project (Barr; January 2015). A summary of the sensitivity analysis method is provided below:

- For MODFLOW calibration, use groundwater baseflows listed in Table 3.
- Perform a complete recalibration of the current-conditions MODFLOW model using higher groundwater baseflows (Table 3) and groundwater levels measured in monitoring wells completed in both surficial deposits and bedrock.
- Transfer results of recalibrated MODFLOW Model to the Mine Site GoldSim model. These mainly include higher pit inflows, higher hydraulic conductivities of surficial deposits, and higher aquifer recharge rates.
- Consistent with previous Co-lead Agencies recommendations for the GoldSim model, increase average discharge from Northshore into the Partridge River from 1.0 to 2.6 cfs and increase the sulfate concentration of this discharge from 22 to 28 mg/L.
- Using the current-conditions GoldSim model, perform a complete recalibration of surface runoff chemical concentrations.
- With the new (sensitivity) inputs, run the GoldSim model to perform a complete NorthMet Project Proposed Action effects analysis.
- Evaluate the effects of higher groundwater baseflows on GoldSim-predicted surface and groundwater concentrations, and determine if these concentrations lead to modeled exceedances of applicable water quality evaluation criteria.

The Co-lead Agencies acknowledge that the sensitivity recalibration of the Mine Site MODFLOW model used the previous water-level elevation for the Northshore pits (493 m msl) rather than the range of 483 to 499 m msl recommended by GLIFWC. The stated purpose of the MODFLOW model is to predict pit inflows and characterize hydrogeologic conditions between the NorthMet mine pits and the Partridge River. Given this purpose, the Co-lead Agencies consider that using 493 m msl for Northshore pit water levels to be an adequate approximation to be used in the model for the groundwater baseflow sensitivity analysis. For additional information on different Northshore Mine pit lake elevations, see: "Co-lead Agencies' Consideration of Possible Mine Site Bedrock Northward Flowpath;" Interagency Technical Memorandum; June 22, 2015 [review draft].

Detailed results of the groundwater baseflow sensitivity analysis are presented in the report "Sensitivity Analysis of the NorthMet Water Quality Models –Version 2 (Barr; January 2015). A general summary of the results is provided below:

- Year 20 West Pit groundwater inflows transferred from MODFLOW to GoldSim increased from 80 to 140 gpm.

- Year 11 East Pit groundwater inflows transferred from MODFLOW to GoldSim increased from 760 to 860 gpm.
- Median (P50) aquifer recharge transferred from MODFLOW to Goldsim increased from 0.75 to 2.9 in/yr.
- Median (P50) hydraulic conductivities for the 5 surficial groundwater flowpaths in GoldSim increased as follows:
    - West Pit flowpath: from 1.31 to 5.15 m/day;
    - Overburden Storage Laydown Area (OSLA) flowpath: from 3.55 to 5.26 m/day;
    - Waste Water Treatment Facility (WWTF) flowpath: from 0.88 to 2.53 m/day;
    - Ore Surge Pile (OSP) flowpath: from 0.52 to 2.01 m/day; and
    - East Pit - Cat 2/3 Stockpile flowpath: from 1.94 to 7.59 m/day.

Regarding groundwater quality, the effect of increased groundwater baseflows on GoldSim-predicted impacts is summarized as follows:

- There was more rapid transport (reduced travel time) of solutes from Mine Site sources to the groundwater evaluation locations and to the Partridge River.
- Peak groundwater concentrations at the groundwater evaluation locations tended to be higher.
- In no case was there a new exceedance of a groundwater evaluation criteria at the 90th percentile (P90) concentration.

Regarding surface water quality in the Partridge River, there were noticeable increases in the concentrations of some constituents for the high groundwater baseflow model. However, no constituents exceeded their surface water quality evaluation criteria except for aluminum and sulfate, which occurred in both the FEIS and high groundwater baseflow models due to elevated background concentrations rather than the influence of the NorthMet Project Proposed Action. For these:

Aluminum. For the high groundwater baseflow model, the predicted frequency of aluminum exceedance for the NorthMet Project Proposed Action (when Continuation of Existing Conditions [CEC] does not) was nearly identical to results of the FEIS model and did not exceed 1.6% when evaluated using annual maximum concentrations.

Sulfate. For the high groundwater baseflow model, the predicted frequency of sulfate exceedance at SW-005 (where the 10 mg/L wild rice standard applies) is similar to the FEIS model. A comparison of the high groundwater baseflow model and results of the FEIS model is provided in Table 4. For the time period of 0 to 55 mine years, the frequency of exceedance for the NorthMet Project Proposed Action (when CEC does not exceed) is zero or very small for both the FEIS model and high groundwater baseflow model. For the time period of 55 to 200 years, the frequency of exceedance is zero for both models when P50 concentrations are considered. For P90 concentrations, the frequency of exceedance is zero for the FEIS model and 3.6% for the high groundwater baseflow model. The 3.6% frequency of exceedance in the high groundwater baseflow model is below the screening criterion of 10% used in previous PolyMet evaluations and the more conservative 5% used in the FEIS. Note that for the high groundwater baseflow model, the maximum difference in sulfate concentrations between NorthMet Project Proposed Action and CEC conditions for all time steps is only 0.27 mg/L.

Table 4 GoldSim-Predicted Sulfate Concentrations at SW-005 for FEIS Model (Version 6) and High Groundwater Baseflow Model [a]

Time Period (myr)	Description	Units	Based on P50 Values		Based on P90 Values	
			FEIS V6	High Baseflow	FEIS V6	High Baseflow
0-55[1]	Percentage of time that PA concentration > 10 mg/L	%	29.0	33.4	100.0	100.0
	Percentage of time that CEC concentration > 10 mg/L	%	28.9	33.4	100.0	100.0
	Percent of time that PA concentration > 10 mg/L ***and*** CEC concentration <= 10 mg/L	%	0.3	0.0	0.0	0.0
	Maximum (PA concentration - CEC concentration)	mg/L	0.055	0.101	0.087	0.153
55-200[2]	Percentage of time that PA concentration > 10 mg/L	%	0.2	0.2	100.0	93.4
	Percentage of time that CEC concentration > 10 mg/L	%	0.2	0.2	100.0	91.4
	Percent of time that PA concentration > 10 mg/L ***and*** CEC concentration <= 10 mg/L	%	0.0	0.0	0.0	3.6
	Maximum (PA concentration - CEC concentration)	mg/L	0.273	0.268	0.102	0.265

PA NorthMet Project Proposed Action concentration

CEC Continuation of Existing Conditions concentration

CRT Applicable evaluaton criterion (10 mg/L)

(1) Northshore discharges 2.6 cfs with sulfate concentration of 28 mg/L; no WWTF discharge

(2) WWTF discharges at average rate of 0.67 cfs with sulfate concentration of 9 mg/L; no Northshore discharge

(a) FEIS V6 values are the same as those reported in PFEIS Table 5.2.2-34

For Colby Lake, exceedances are predicted in the FEIS model for arsenic, copper, iron, and manganese. These exceedances are also predicted in the high groundwater baseflow model, but the frequency of exceedance for the NorthMet Project Proposed Action (when CEC does not) did not exceed 4% for any constituent evaluated using annual maximum concentrations.

Based on the groundwater baseflow sensitivity analysis, the Co-lead Agencies conclude the following:

- Groundwater and surface water constituent concentrations show observable sensitivity to groundwater baseflow values, with higher concentrations generally associated with higher groundwater baseflows.
- Despite the effect on concentrations, the NorthMet Project Proposed Action does not exceed applicable water quality evaluation criteria, even for the unlikely case of groundwater baseflows being 4 times higher than the values used in the FEIS.

3.0 Discussion

The Co-lead Agencies have previously concluded that groundwater baseflow values used to calibrate the current-conditions Mine Site MODFLOW model, and as inputs to the GoldSim water quality model, are reasonable estimates of current hydrologic conditions for the Partridge River at the NorthMet Mine Site. However, because there are differences between the Co-lead Agencies and the Cooperating Agencies on the issue of groundwater baseflow, a sensitivity analysis was performed using groundwater baseflows that were 4 times higher than the values used in the FEIS and also higher than the range of values recommended by GLIFWC in its letter dated June 18, 2015. The Co-lead Agencies believe that the

groundwater baseflow sensitivity analysis adequately responds to the Option #2 recommendation made by GLIFWC in terms of understanding potential impacts to water quantity and quality.

The results of the groundwater baseflow sensitivity analysis indicate that estimated constituent concentrations show some sensitivity to the increase in groundwater baseflow values at the respective evaluation locations. Specifically:

> Groundwater. For the high groundwater baseflow model there were observable differences between it and the FEIS Version 6 model results, but did not result in any new exceedances of the applicable groundwater quality evaluation criteria for the NorthMet Project Proposed Action. There was however more rapid transport (reduced travel time) of solutes from Mine Site sources to the groundwater evaluation locations and to the Partridge River under the high groundwater baseflow model.
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> Surface Water. There were noticeable increases in the concentrations of some constituents in the Partridge River and Colby Lake for the high groundwater baseflow model. However, where surface water quality evaluation criteria were exceeded, the frequency of exceedance of the NorthMet Proposed Action Project (when CEC does not exceed) was either very similar to the FEIS model results or did not exceed the 5% screening criterion used in the FEIS.

The above observations apply even for the unlikely case of groundwater baseflows being 4 times higher than the values used in the FEIS, which is higher than GLIFWC's Option #2. Consequently the Co-lead Agencies conclude there is no methodology-based justification for changing the groundwater baseflow values used in calibrating the EIS Mine Site MODFLOW and GoldSim models for water resources impact evaluation.

4.0 References

Barr Engineering Company (Barr). February 27, 2015. NorthMet Project, Water Modeling Data Package, Volume 1 – Mine Site, version 14. Technical report prepared for PolyMet Mining, Inc.

Barr Engineering Company (Barr). January 2015. Sensitivity Analysis of the NorthMet Water Quality Models – Version 2, NorthMet Project. Technical report prepared for PolyMet Mining, Inc.

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